EFFICIENCY IN WIRELESS NETWORK

FIELD

[0001] The invention relates generally to wireless networks. More particularly, the invention relates to controlling the amount of discovery protocol messages.

BACKGROUND

[0002] In some wireless networks, a device may use active scanning to find out available networks for communication. Active scanning refers to a method where the device transmits a scanning request message. If the device receives a scanning response message from an access node, it may determine that there is a network nearby to which the device may possibly connect. If the neighborhood comprises a large number of devices and/or a large number of access nodes, frequent transmission of these scanning messages may cause congestion.

BRIEF DESCRIPTION OF THE INVENTION

[0003] According to an aspect of the invention, there are provided methods as specified in claims **1** and **15**.

[0004] According to an aspect of the invention, there are provided apparatuses as specified in claims **17**, **31**, and **33**.

[0005] According to an aspect of the invention, there is provided a computer program product as specified in claim **34**.

[0006] According to an aspect of the invention, there is provided a computer-readable distribution medium carrying the above-mentioned computer program product.

[0007] According to an aspect of the invention, there is provided an apparatus comprising processing means configured to cause the apparatus to perform any of the embodiments as described in the appended claims.

[0008] According to an aspect of the invention, there is provided an apparatus comprising processing means for performing any of the embodiments as described in the appended claims.

[0009] Embodiments of the invention are defined in the dependent claims.

LIST OF DRAWINGS

[0010] In the following, the invention will be described in greater detail with reference to the embodiments and the accompanying drawings, in which

[0011] FIG. **1** presents an example of an extended service set in a wireless local area network (WLAN);

[0012] FIGS. **2**A and **2**B show examples of an active and a passive scanning;

[0013] FIG. **3**A shows a method according to an embodiment;

[0014] FIG. **3**B shows an example of a plurality of channels with different utilization ratios;

[0015] FIG. **4**A illustrates an example way of determining a utilization ratio for a channel;

[0016] FIG. **4**B shows an example of changing the transmission time of a probe request, according to an example;

[0017] FIGS. **5** to **9**A present methods according to some embodiments;

[0018] FIG. **9**B depicts an example of a plurality of channels with different utilization ratios;

[0019] FIGS. **10** to **13**A illustrate methods according to some embodiments;

[0020] FIG. **13**B shows an information element according to an embodiment; and

[0021] FIGS. **14** and **15** illustrate apparatuses according to some embodiments.

DESCRIPTION OF EMBODIMENTS

[0022] The following embodiments are exemplary. Although the specification may refer to "an", "one", or "some" embodiment(s) in several locations of the text, this does not necessarily mean that each reference is made to the same embodiment(s), or that a particular feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments.

[0023] The number of IEEE 802.11-enabled mobile devices is ever increasing. The IEEE 802.11 is a set of standards for implementing wireless local area network (WLAN), also known as the Wi-Fi. One problem in the current specifications may occur when a large number of stations (STAs) are constantly entering and leaving the coverage area of an extended service set (ESS), possibly comprising multiple access points (APs). In such scenario the network may become congested due to large number of discovery protocol messages, for example. A task group of the IEEE 802.11, namely TGai, focuses on the issue and tries to minimize the time that STAs **108** to **114** spend in the initial link setup while maintaining secure authentication. However, current solutions do not meet the requirements set for scalability and resource efficiency in the scenario with large number of stations and access points, for example.

[0024] In the nomenclature of IEEE 802.11, a service set comprises all the devices associated with the WLAN/WiFi. Referring to FIG. **1**, a basic service set (BSS) **102**, **106** comprises a single access point (AP) **100** or **104**, providing coverage to a corresponding coverage or service area, together with all associated stations (STAs) **108** to **114**. As shown, the STAs **108** to **114** may comprise a mobile phone, a palm computer, a wrist computer, a laptop, a personal computer, etc. Thus, the STA **108** to **114** may be any device capable to access the WLAN radio air interface. The AP **100***s* and **104**, each acts as a master to control the stations **108** to **114** within the corresponding BSS **102**, **106**, respectively. The access point **100**, **104** may be a WLAN base station, for example. The extended service set (ESS) **120**, on the other hand, is a set of one or more interconnected BSSs **102**, **106** and integrated local area networks that appear as a single BSS to the logical link control layer at any station **108** to **114** associated with one of the BSSs **102**, **106**. The set of interconnected BSSs **102**, **106** may apply the same channel, or communicate on different channels to boost aggregate throughput. FIG. **1** also shows a distribution system (DS) **122** for interconnecting the access points of the ESS **120**. The DS **122** may be a wireless or a wired network element allowing the access points to communicate with each other.

[0025] As said, there may be vast number of APs **100**, **104** and stations **108** to **114** in one ESS **120**, which may lead to congestion in the network. Congestion may occur when the capacity of a shared resource is exceeded. Network congestion may occur due to several reasons, such as the number of the STAs **108** to **114**, the arrival rate of the STAs **108** to **114**, and local contention. An example scenario where congestion may occur is in a discovery process for the AP **100**, **104** to connect with. In particular, when any of the stations **108** to **114** enters the ESS **120**, the stations **108** to **114** may need to do an initial setup with an AP **100** or **104** to establish WLAN